deep space network

Impact to GSFC Missions if DSN 26 Meter Subnet is Decommissioned

Presented to GSFC
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- Purpose
  - Determine the impact to users of the DSN assuming the DSN 26 Meter Subnet will be decommissioned on September 30, 2008
  - Analyze loading on the 34 Meter Beam Wave Guide 1 (34BWG1) subnet with mission requirements formerly assigned to the 26 Meter subnet (26M) for the period of October 1, 2008 – December 31, 2012
    - Can the 34BWG1 subnet accommodate the additional loading from the Ongoing and Advanced Planning Mission sets?
    - Can we forecast that DSN will achieve at least 85% supportability?

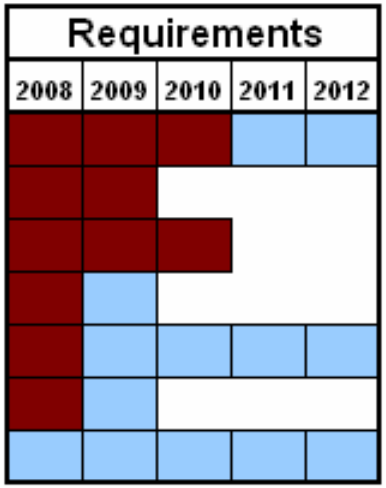
- DSN Resource Assumptions
  - 26Meter Subnet will be retired September 30, 2008
  - A new 12 Meter Near-Earth Ka-Band antenna array will be implemented at Goldstone primarily to support LRO, but will require support from DSS-34 and DSS-54 by September 30, 2008

- Mission Set Assumptions
  - Current approved Ongoing and Advanced missions from the February 2005 RARB
  - Modified Ongoing mission set - SSMO missions were modified as suggested by Goddard to predict probable support scenarios for current missions
  - Future mission set is not considered in this study as the requirements available are not expected to impact the assets under study
  - Future Lunar missions may be supported by 12 Meter antenna arrays. If these 12 Meter antennas are not implemented then this study should be redone to include the future Lunar support requirements.

Modifications Made to Current Ongoing Mission Set

- All requirements remain unchanged, only extended as shown except for SOHO where requirements after 2008 were decreased to two 2 hour passes per day and a maneuver every 90 Days consisting of three 8 hour passes.

Modified Current Flight Missions		
Project	Current EOM	Study EOM
ACE	9/30/2010	12/31/2012
Cluster	12/31/2009	12/31/2009
IMAGE	9/30/2010	9/30/2010
INTEGRAL	12/31/2008	9/30/2009
SOHO	12/31/2008	12/31/2012
WMAP	9/30/2008	9/30/2009
Wind	9/30/2006	12/31/2012



- Analysis indicates that the off-loading of the 26 Meter subnet support to the 34 Meter BWG1 subnet will:
  - In 2008 severely decreased supportability is caused by the 26 Meter Decommissioning forecasted during the period of October 1, – December 31, 2008. Weekly supportability Percentage losses range from 14.5% - 26.9%.
  - In 2009 there is very little impact from the 26 Meter decommissioning. Monthly supportability Percentage losses range from 0.8% - 7.9%.
  - In 2010 there is very little impact from the 26 Meter decommissioning. Monthly supportability Percentage losses range from -0.3% - 5.3%. Heavy loading throughout most of the year is causing severe contention.
  - In 2011 there is very little impact from the 26 Meter decommissioning. Monthly supportability Percentage losses range from 1.4% - 4.2%. Heavy loading early in the year is causing moderate contention.
  - In 2012 there is very little impact from the 26 Meter decommissioning. Monthly supportability Percentage losses range from 0.5% - 3.4%. At this time loading levels overall are workable in 2012.

Resource Allocation Planning & Scheduling Office (RAPSO)

Jet Propulsion Laboratory
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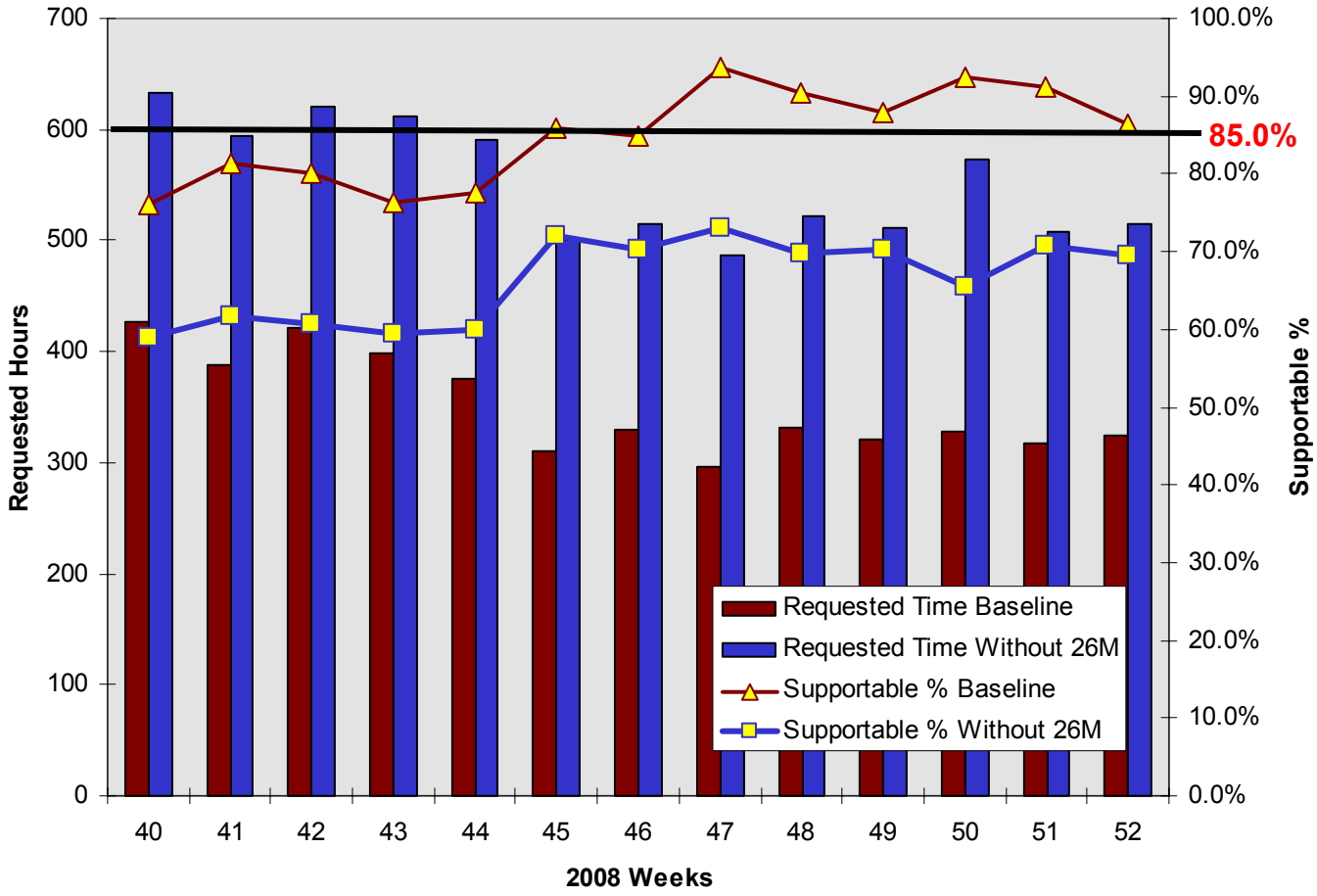
2008 Weekly 34BWG1 Supportable Time and Requested Hours with 26M In-Service vs. Decommissioned



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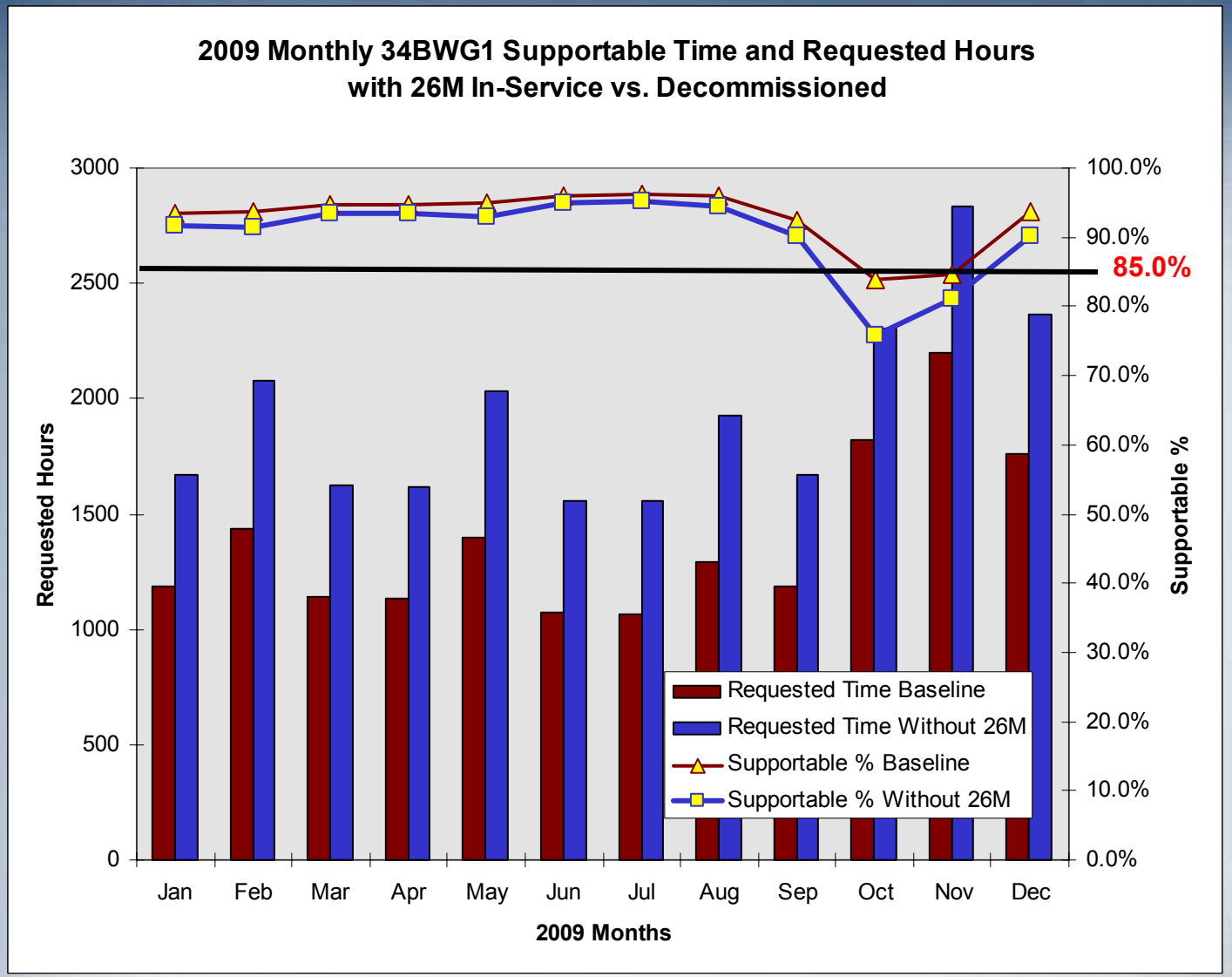
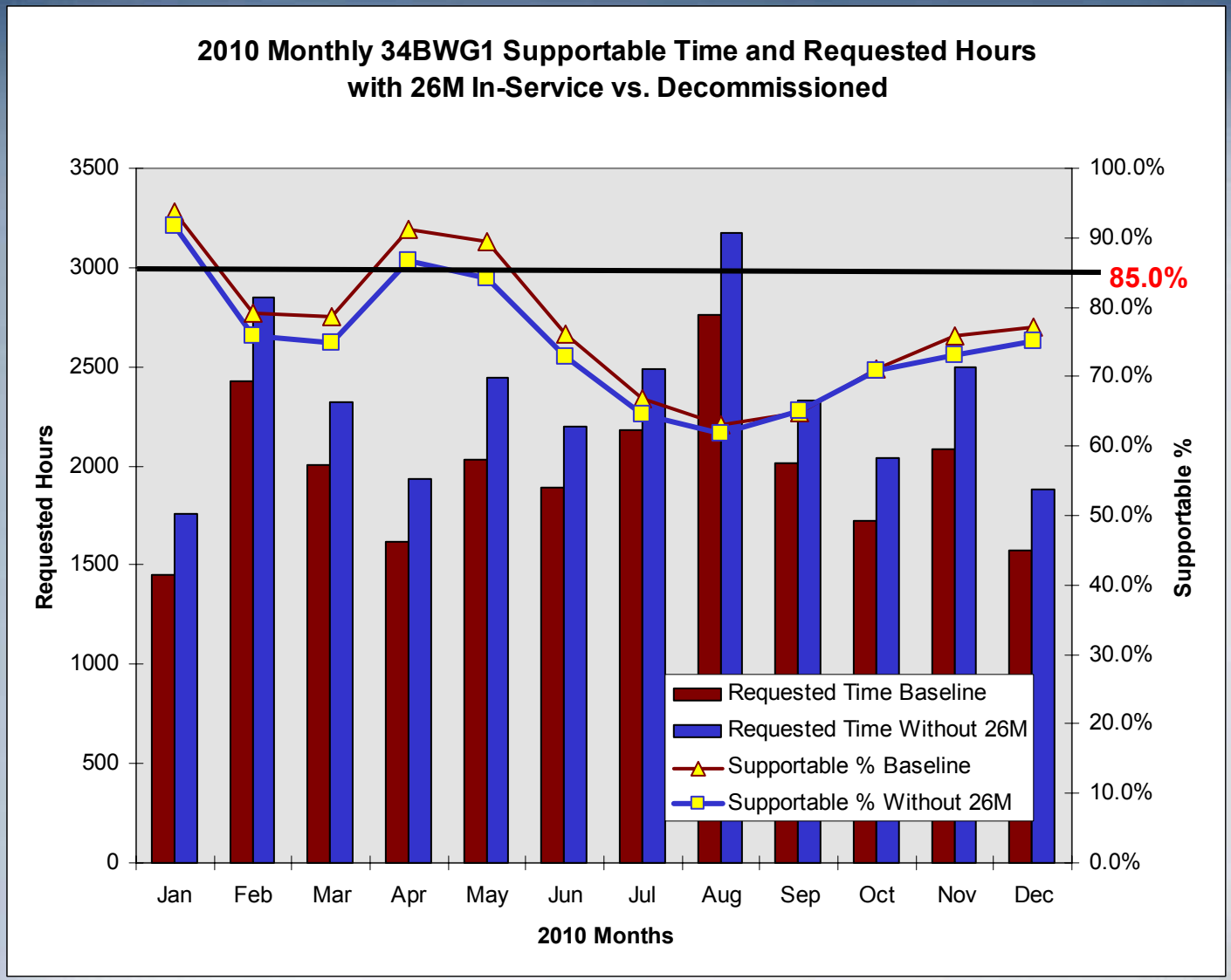
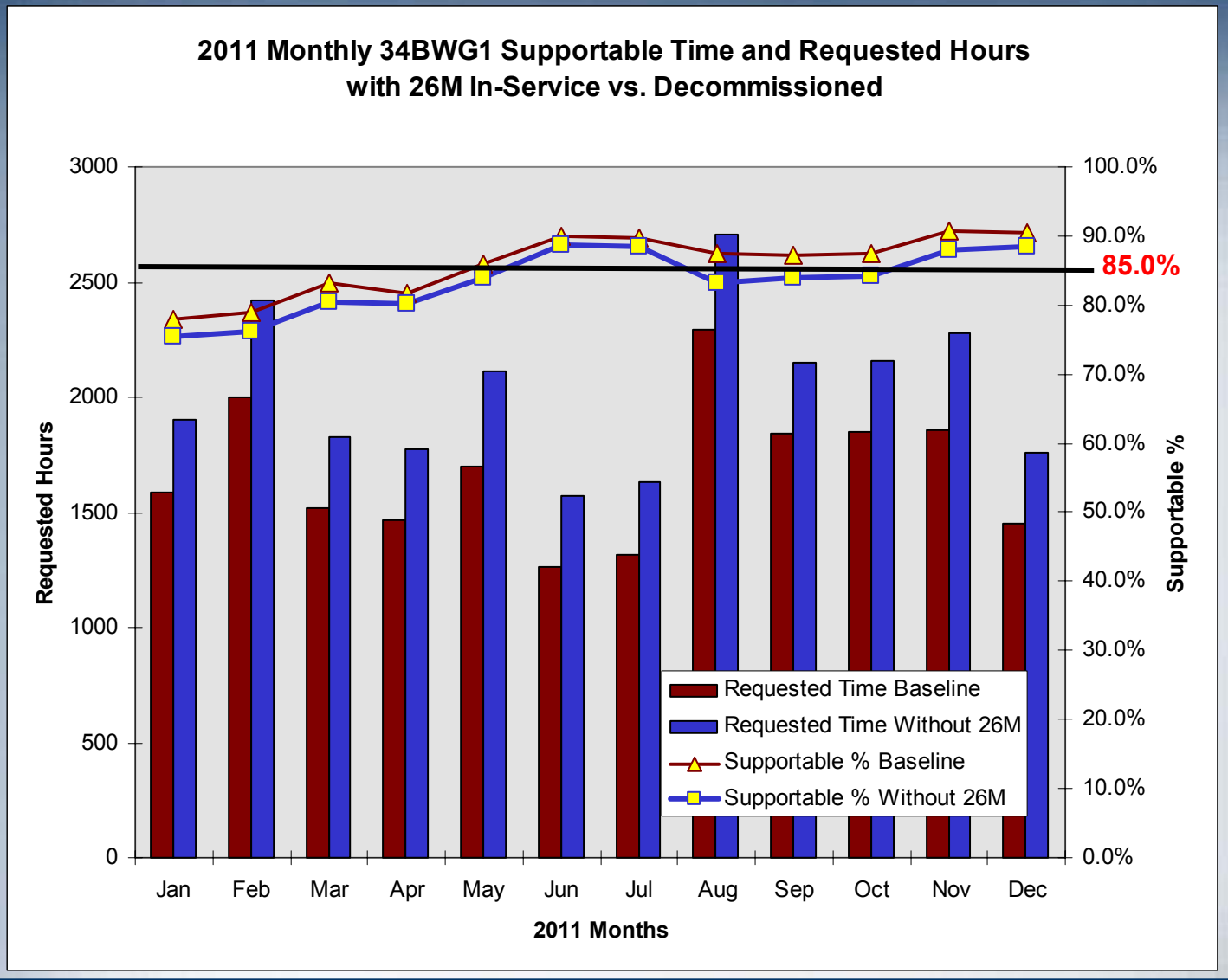



2010 Monthly 34BWG1 Supportable Time and Requested Hours
with 26M In-Service vs. Decommissioned
Requested Hours
Supportable %
3500
3000
2500
2000
1500
1000
500
0
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
85.0%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2010 Months
Requested Time Baseline
Requested Time Without 26M
Supportable % Baseline
Supportable % Without 26M


2011 Monthly 34BWG1 Supportable Time and Requested Hours
with 26M In-Service vs. Decommissioned
Requested Hours
Supportable %
3000
2500
2000
1500
1000
500
0
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
85.0%
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2011 Months
Requested Time Baseline
Requested Time Without 26M
Supportable % Baseline
Supportable % Without 26M

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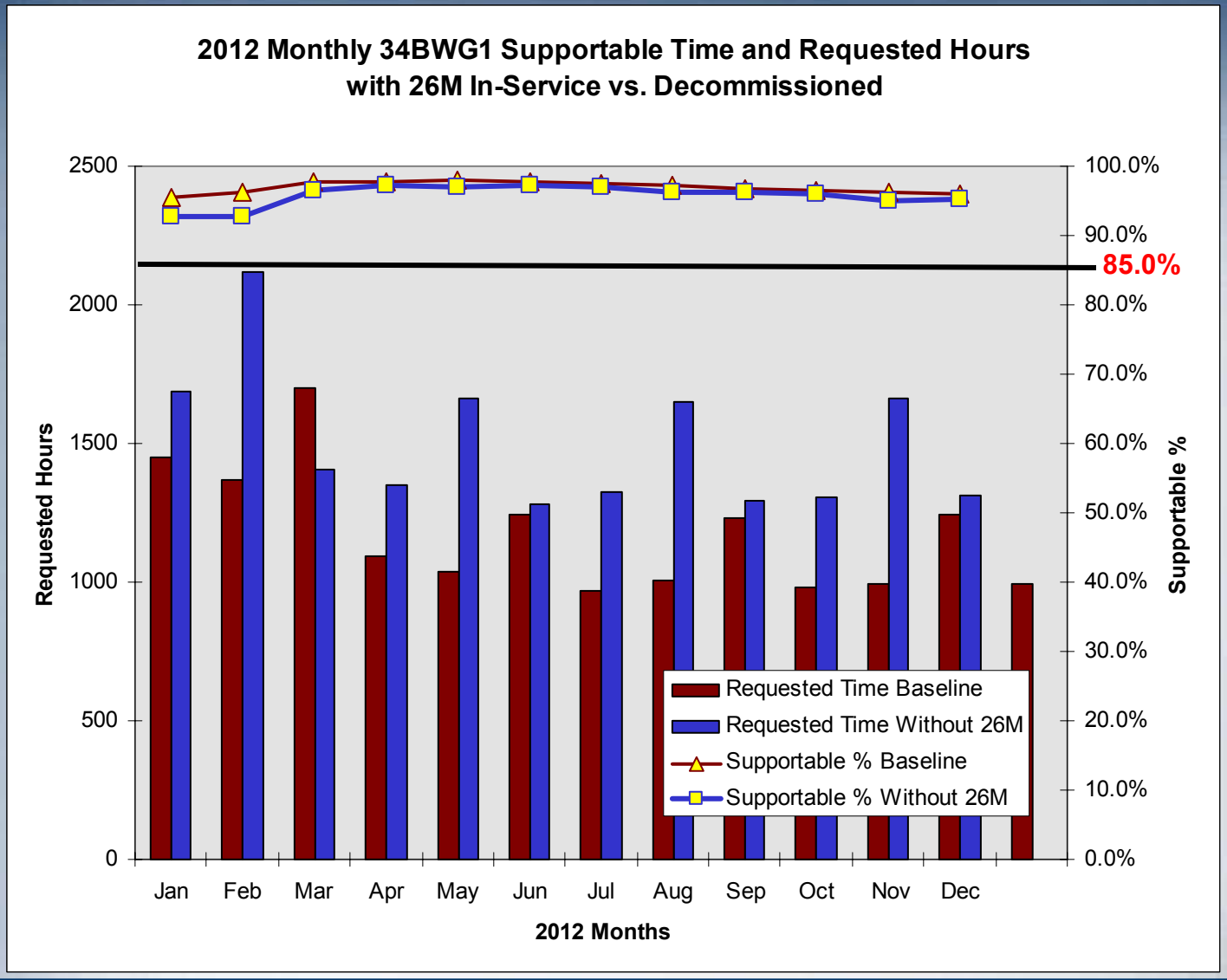

- Conclusions
  - Heavy impact in the October – December time frame of 2008 when it is predicted that more missions will require 26 Meter support.
  - Overall the usage after 2008 of the 26 Meter subnet is minimal therefore causing very little impact to the 34 BWG1 subnet.
  - In many months between 2009 - 2012 the 34 BWG1 subnet is already oversubscribed, the 26 Meter loading is of little or no impact to the 34 BWG1 subnet.

- Recommendations
  - It is recommended that the 26 Meter subnet not be decommissioned until January of 2009

The results of this study are subject to change, in that network loading changes, as requirements for planned missions are input and updated and periods of antenna downtime are identified.

Resource Allocation Planning & Scheduling Office (RAPSO)

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SSMO Consolidated ULP 2008 – 2012

With the 26 Meter Subnet in Service

SSMO Missions With 26 Meter in Service

VP			Durations		Calibration		January					February				March				April					May				June				July					August				September				October					November				December				
Object	User	Resource	Ave	Min	Pre	Post	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
2008																																																												
SUN	ACE.	DSS-16,66	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	ACE.	DSS-46	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
CLUC	CLU2 1/2/3/4 SSO	S-16/27/24/15/14	2.0	2.0	0.50	0.25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
CLUC	CLU2 1/2/3/4 SSO	DSS-46/34/45/43	2.0	2.0	0.50	0.25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
CLUC	CLU2 1/2/3/4 SSO	DSS-16/27/24/15	2.0	2.0	0.50	0.25																																	2																				
CLUC	CLU4 1/2/3/4 MSO	DSS-16/27/24/15	1.5	1.0	0.50	0.25		1				1				1				1				1				1				1				1				1				1					1				1				1		
CLUC	CLU4 1/2/3/4 MSO	DSS-46/34/45/43	1.5	1.0	0.50	0.25				1				1				1				1				1				1				1				1				1				1					1				1			1	
NONE	IMAG.	34B1	0.8	0.8	1.00	0.25	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	
NONE	IMAG. SCI Load	34B1	1.5	1.5	1.00	0.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
NONE	INTG	DSS-16	5.3	5.0	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	SOHO	34B1	8.0	4.0	0.70	0.20				2				2																																						2							
SUN	SOHO HSO	DSS-27	8.0	6.0	0.40	0.20																													7	7	7	7	7	7	7	7	7	7	7	7	7												
SUN	SOHO TSO	DSS-27,46,66	8.0	4.0	0.70	0.20				15				8				15				8				8				8				15															15				15							
SUN	SOHO	26M	9.6	4.0	0.70	0.20	7	7	7		7	7	7		7	7	7		7	7	7		7	7	7		7	7	7		7	7	7																7	7	7		7	7	7		7	7	
SUN	SOHO	26M	8.0	4.0	0.70	0.20												2				2				2				2				2															2								2			
SUN	SOHO	26M	1.6	1.6	0.70	0.20	14	14	14	4	14	14	14	4	14	14	14	4	14	14	14	4	14	14	14	4	14	14	14	4	14	14	14	4														4	14	14	14	4	14	14	14	4	14	14	
SUN	SOHO HSO	26M	8.0	4.0	0.70	0.20																													14	14	14	14	14	14	14	14	14	14	14	14	14												
SUN	SOHO TSO	26M	8.0	4.0	0.70	0.20								7								7				7				7																											15			
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													
ASUN	WMAP.	DSS-14,43	0.7	0.6	1.25	0.25	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	
ASUN	WMAP. Mnvr.	DSS-14,43	5.0	4.0	1.25	0.25	1																1																1																1				
ASUN	WMAP. Mnvr.	DSS-14,43	3.0	3.0	1.25	0.25	2																2																2																2				
2009																																																												
SUN	ACE.	DSS-16,66	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
SUN	ACE.	DSS-46	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
CLUC	CLU2 1/2/3/4 SSO	S-16/27/24/15/14	2.0	2.0	0.50	0.25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CLUC	CLU2 1/2/3/4 SSO	DSS-46/34/45/43	2.0	2.0	0.50	0.25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CLUC	CLU4 1/2/3/4 MSO	DSS-16/27/24/15	1.5	1.0	0.50	0.25		1				1				1				1				1				1				1				1				1				1					1				1				1		
CLUC	CLU4 1/2/3/4 MSO	DSS-46/34/45/43	1.5	1.0	0.50	0.25				1				1				1				1				1				1				1				1				1				1					1				1			1	
NONE	IMAG.	34B1	0.8	0.8	1.00	0.25	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
NONE	IMAG. SCI Load	34B1	1.5	1.5	1.00	0.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NONE	INTG	DSS-16	5.3	5.0	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
SUN	SOHO	26M	2.0	1.0	0.70	0.20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SUN	SOHO TCM	26M	8.0	4.0	0.70	0.20								3													3													3													3						
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													
ASUN	WMAP.	DSS-14,43	0.7	0.6	1.25	0.25	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	3													
ASUN	WMAP. Mnvr.	DSS-14,43	5.0	4.0	1.25	0.25	1																1																1																				
ASUN	WMAP. Mnvr.	DSS-14,43	3.0	3.0	1.25	0.25	2																2																2																				
2010																																																												
SUN	ACE.	DSS-16,66	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	ACE.	DSS-46	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
NONE	IMAG.	34B1	0.8	0.8	1.00	0.25	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13														
NONE	IMAG. SCI Load	34B1	1.5	1.5	1.00	0.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1														
SUN	SOHO	26M	2.0	1.0	0.70	0.20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
SUN	SOHO TCM	26M	8.0	4.0	0.70	0.20								3													3													3													3						
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													
2011																																																												
SUN	ACE.	DSS-16,66	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	ACE.	DSS-46	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
SUN	SOHO	26M	2.0	1.0	0.70	0.20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
SUN	SOHO TCM	26M	8.0	4.0	0.70	0.20								3													3													3													3						
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													
2012																																																												
SUN	ACE.	DSS-16,66	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	ACE.	DSS-46	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
SUN	SOHO	26M	2.0	1.0	0.70	0.20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
SUN	SOHO TCM	26M	8.0	4.0	0.70	0.20								3													3													3													3						
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													

Jet Propulsion Laboratory
California Institute of Technology

SSMO Consolidated ULP 2008 – 2012

Without the 26 Meter Subnet in Service

SSMO Missions Without 26 Meter in Service

VP			Durations		Calibration				January				February				March				April					May				June					July				August				September					October				November					December		
Object	User	Resource	Ave	Min	Pre	Post	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
2008																																																												
SUN	ACE.	DSS-24,54	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	ACE.	DSS-34	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
CLUC	CLU2 1/2/3/4 SSO	DSS-24/27/15/14	2.0	2.0	0.50	0.25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
CLUC	CLU2 1/2/3/4 SSO	DSS-34/45/43	2.0	2.0	0.50	0.25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
CLUC	CLU2 1/2/3/4 SSO	DSS-27/24/15	2.0	2.0	0.50	0.25																																	2																				
CLUC	CLU4 1/2/3/4 MSO	DSS-27/24/15	1.5	1.0	0.50	0.25		1				1				1				1				1				1				1				1				1				1					1				1				1		
CLUC	CLU4 1/2/3/4 MSO	DSS-34/45/43	1.5	1.0	0.50	0.25				1				1				1				1				1				1				1				1				1				1					1				1			1	
NONE	IMAG.	34B1	0.8	0.8	1.00	0.25	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	
NONE	IMAG. SCI Load	34B1	1.5	1.5	1.00	0.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
NONE	INTG	DSS-24	5.3	5.0	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	SOHO	34B1	8.0	4.0	0.70	0.20				2				2																																						2							
SUN	SOHO	34B1	9.6	4.0	0.70	0.20	7	7	7		7	7	7		7	7	7		7	7	7		7	7	7		7	7	7		7	7	7																7	7	7		7	7	7		7	7	
SUN	SOHO	34B1	8.0	4.0	0.70	0.20												2				2				2				2				2														2								2			
SUN	SOHO	34B1	1.6	1.6	0.70	0.20	14	14	14	4	14	14	14	4	14	14	14	4	14	14	14	4	14	14	14	4	14	14	14	4	14	14	14	4														4	14	14	14	4	14	14	14	4	14	14	
SUN	SOHO HSO	34B1	8.0	4.0	0.70	0.20																													14	14	14	14	14	14	14	14	14	14	14	14	14												
SUN	SOHO TSO	34B1	8.0	4.0	0.70	0.20								7								7				7				7																										15			
SUN	SOHO HSO	DSS-27	8.0	6.0	0.40	0.20																													7	7	7	7	7	7	7	7	7	7	7	7	7												
SUN	SOHO TSO	DSS-27,34,54	8.0	4.0	0.70	0.20				15				8				15				8				8				8				15														15				15							
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													
ASUN	WMAP.	DSS-14,43	0.7	0.6	1.25	0.25	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	
ASUN	WMAP. Mnvr.	DSS-14,43	5.0	4.0	1.25	0.25	1																1																1																1				
ASUN	WMAP. Mnvr.	DSS-14,43	3.0	3.0	1.25	0.25	2																2																2																2				
2009																																																												
SUN	ACE.	DSS-24,54	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
SUN	ACE.	DSS-34	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
CLUC	CLU2 1/2/3/4 SSO	DSS-34/45/43	2.0	2.0	0.50	0.25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CLUC	CLU2 1/2/3/4 SSO	DSS-27/24/15/14	2.0	2.0	0.50	0.25	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CLUC	CLU4 1/2/3/4 MSO	DSS-27/24/15	1.5	1.0	0.50	0.25		1				1				1				1				1				1				1				1				1				1					1				1				1		
CLUC	CLU4 1/2/3/4 MSO	DSS-34/45/43	1.5	1.0	0.50	0.25				1				1				1				1				1				1				1				1				1				1					1				1			1	
NONE	IMAG.	34B1	0.8	0.8	1.00	0.25	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
NONE	IMAG. SCI Load	34B1	1.5	1.5	1.00	0.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
NONE	INTG	DSS-24	5.3	5.0	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
SUN	SOHO	34B1	2.0	1.0	0.70	0.20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
SUN	SOHO TCM	34B1	8.0	4.0	0.70	0.20								3													3													3													3						
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													
ASUN	WMAP.	DSS-14,43	0.7	0.6	1.25	0.25	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	7	7	7	7	7	3													
ASUN	WMAP. Mnvr.	DSS-14,43	5.0	4.0	1.25	0.25	1																1																1																				
ASUN	WMAP. Mnvr.	DSS-14,43	3.0	3.0	1.25	0.25	2																2																2																				
2010																																																												
SUN	ACE.	DSS-24,54	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	ACE.	DSS-34	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
NONE	IMAG.	34B1	0.8	0.8	1.00	0.25	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13														
NONE	IMAG. SCI Load	34B1	1.5	1.5	1.00	0.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1														
SUN	SOHO	34B1	2.0	1.0	0.70	0.20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
SUN	SOHO TCM	34B1	8.0	4.0	0.70	0.20								3													3													3													3						
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													
2011																																																												
SUN	ACE.	DSS-24,54	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	ACE.	DSS-34	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
SUN	SOHO	34B1	2.0	1.0	0.70	0.20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
SUN	SOHO TCM	34B1	8.0	4.0	0.70	0.20								3													3													3													3						
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													
2012																																																												
SUN	ACE.	DSS-24,54	3.5	3.5	0.70	0.20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	ACE.	DSS-34	1.0	1.0	0.70	0.20	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
SUN	SOHO	34B1	2.0	1.0	0.70	0.20	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
SUN	SOHO TCM	34B1	8.0	4.0	0.70	0.20								3													3													3													3						
SUN	WIND	34B1	2.5	2.5	1.00	0.25	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
SUN	WIND TCM	DSS-24	3.0	2.0	1.00	0.25	1													1													1													1													